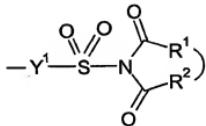


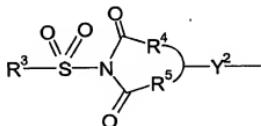
## WHAT IS CLAIMED IS:

1. An acoustic sensor comprising a surface comprising:

5 (a) a soluble polymer having two or more pendant groups independently selected from the group consisting of functional groups having the following formulas:

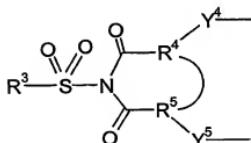


(I);



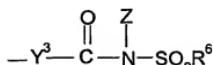
10

(II);



15 (III);

and



(IV);

20 wherein:

-104-

R<sup>1</sup> and R<sup>2</sup> together with a dicarboximide group to which they are attached form a four to eight membered heterocyclic or heterobicyclic group that can be fused to an optional aromatic group, optional saturated or unsaturated cyclic group, or optional saturated or unsaturated bicyclic group;

5 R<sup>3</sup> is an alkyl, aryl, aralkyl, or -NR<sup>5</sup>R<sup>b</sup> wherein R<sup>a</sup> and R<sup>b</sup> are each an alkyl group or taken together with the nitrogen atom to which they are attached form a four to eight membered heterocyclic group;

10 R<sup>4</sup> and R<sup>5</sup> together with a dicarboximide group to which they are attached form a four to eight membered heterocyclic or heterobicyclic group that can be fused to an optional aromatic group, optional saturated or unsaturated cyclic group, or optional saturated or unsaturated bicyclic group;

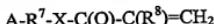
15 R<sup>6</sup> is an alkyl, fluoroalkyl, chloroalkyl, aryl, -NR<sup>c</sup>R<sup>d</sup> wherein R<sup>c</sup> and R<sup>d</sup> are each an alkyl group or taken together with the nitrogen atom to which they are attached form a four to eight membered cyclic group, or R<sup>6</sup> taken together with R<sup>e</sup> and the groups to which they are attached form the four to eight membered heterocyclic or heterobicyclic group that can be fused to the optional aromatic group, optional saturated or unsaturated cyclic group, or optional saturated or unsaturated bicyclic group;

20 Z is an alkyl, aryl, or -(CO)R<sup>e</sup> wherein R<sup>e</sup> together with R<sup>6</sup> and groups to which they are attached form a four to eight membered heterocyclic or heterobicyclic group having a nitrogen heteroatom and a sulfur heteroatom, wherein said heterocyclic or heterobicyclic group can be fused to an optional aromatic group, optional saturated or unsaturated cyclic group, or optional saturated or unsaturated bicyclic group;

25 Y<sup>1</sup>, Y<sup>2</sup>, and Y<sup>3</sup> are each independently a single bond or a divalent group selected from the group consisting of an alkylene, heteroalkylene, arylene, carbonyl, carbonyloxy, carbonylimino, oxy, thio, -NR<sup>f</sup>- where R<sup>f</sup> is hydrogen or alkyl, and combinations thereof; and

Y<sup>4</sup> and Y<sup>5</sup> are each a bond; or

(b) monomers of the formula:



wherein:

A is selected from the group consisting of functional groups having the formulas (I), (II), and (IV);

X is -N(R<sup>9</sup>)- or -O-;

R<sup>7</sup> is a divalent group selected from the group consisting of alkylene, heteroalkylene, arylene, heteroarylene, and combinations thereof, wherein the alkylene and heteroalkylene optionally include one or more carbonyls;

5 R<sup>8</sup> is hydrogen or methyl; and

R<sup>9</sup> is hydrogen or a C<sub>1-6</sub> alkyl group; or

(c) a multifunctional compound of the formula:

(A')<sub>y</sub>-Q

wherein:

10 each A' is independently selected from the group consisting of functional groups having the formulas (I), (II), and (IV);

Q is a single bond or an y-valent atom or group; and

y is an integer of 2 to 10;

with the proviso that Q, Y<sup>1</sup>, Y<sup>2</sup>, and Y<sup>3</sup> are free of disulfide groups; or

15 (d) a compound having one or two functional groups represented by

Formulas I, II, or IV, wherein each Y group (Y<sup>1</sup>, Y<sup>2</sup>, Y<sup>3</sup>) is bonded to a substrate reactive-functional group independently selected from the group consisting of a carboxy, halocarbonyl, halocarbonyloxy, cyano, hydroxy, mercapto, isocyanato, halosilyl, alkoxyisilyl, acyloxyisilyl, azido, aziridinyl, haloalkyl, tertiary amino, primary aromatic amino, secondary aromatic amino, disulfide, alkyl disulfide, benzotriazolyl, phosphono, phosphoroamido, phosphato, ethylenically unsaturated group, and combinations thereof; or

20 (e) a polymer derived from one or more different monomers, wherein at least one monomer is a (meth)acrylate monomer, and wherein the polymer does not include functional groups having formulas I, II, III, or IV; or

25 (f) a polymer derived from N-vinylcarbazole and optionally other ethylenically unsaturated monomers; or

(g) a VF<sub>2</sub>-containing fluoropolymer;

(h) a polyepoxide; or

30 combinations thereof.

2. The acoustic sensor of claim 1 which is a surface acoustic wave sensor.

3. The acoustic sensor of claim 2 which is a shear horizontal surface acoustic wave sensor.

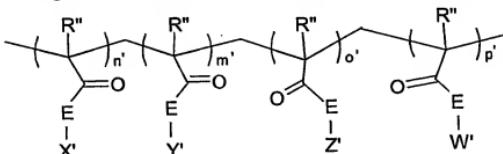
4. The acoustic sensor of claim 3 which can operate in the Love mode.

5

5. The acoustic sensor of claim 1 comprising a waveguide layer and an immobilization overlayer.

10 6. The acoustic sensor of claim 5 wherein the immobilization layer comprises the soluble polymer having two or more pendant groups independently selected from the group consisting of functional groups (I), (II), (III), and (IV).

7. The acoustic sensor of claim 6 wherein the soluble polymer is a random polymer having a molecular weight of at least 1000, and is of the following formula:



15

wherein:

each R'' is independently H or CH<sub>3</sub>;

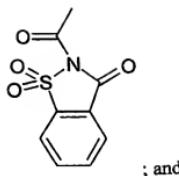
each E is -O- or -NR<sup>f</sup>-, where R<sup>f</sup> is hydrogen or alkyl;

m', n', o', p' represent the number of times each moiety is present in the polymer;

20

X', Y', Z', and W' are independently selected from the group consisting of alkyl, aryl, hydroxy ester, alkoxyalkyl, alkoxyaryl, ether, fluoroalkyl, trialkoxysilylalkyl, and N-containing groups; and

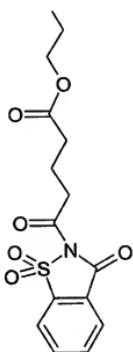
at least one of X', Y', Z', or W' includes an acylsulfonamide group of the following formula:



; and

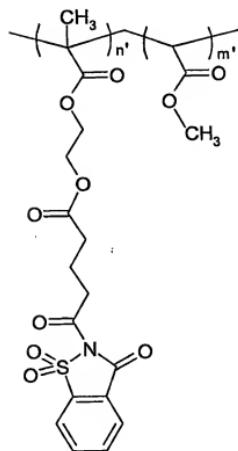
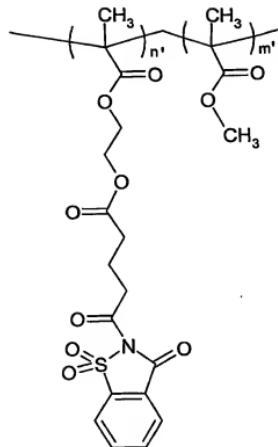
the polymer includes at least two distinct moieties.

8. The acoustic sensor of claim 7 wherein at least one of  $\text{X}'$ ,  $\text{Y}'$ ,  $\text{Z}'$ , or  $\text{W}'$  is the  
5 following group:

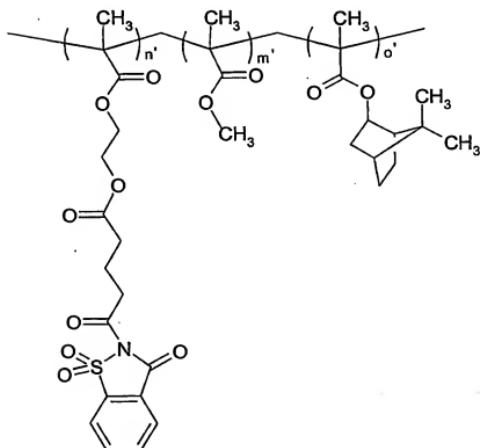
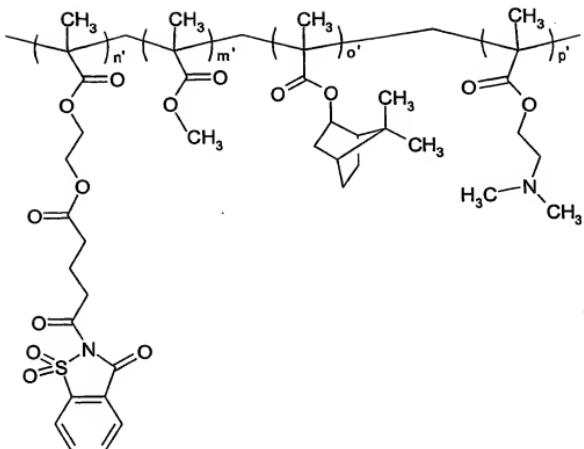


9. The acoustic sensor of claim 8 wherein the soluble polymer is selected from the  
group consisting of:

-108-

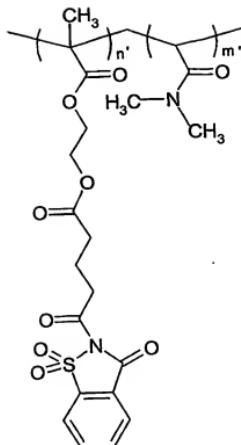


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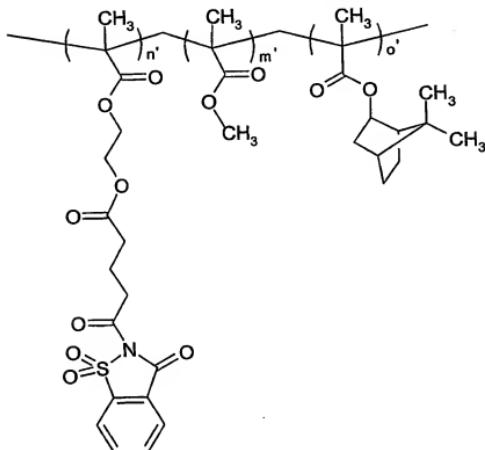
and

-110-



wherein  $m'$ ,  $n'$ ,  $o'$ , and  $p'$  represent the number of times each moiety is present in the polymer.

5 10. The acoustic sensor of claim 9 wherein the soluble polymer has the formula:



11. The acoustic sensor of claim 5 wherein the waveguide layer comprises the polymer derived from two or more different monomers wherein at least one is a (meth)acrylate monomer, the polymer derived from N-vinylcarbazole, the polyepoxide, the VF<sub>2</sub>-containing fluoropolymer, or combinations thereof.

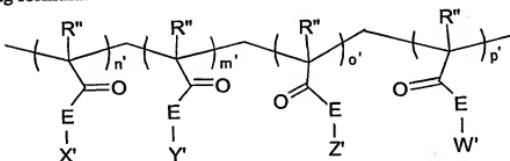
12. The acoustic sensor of claim 11 wherein the waveguide layer comprises the polymer derived from two or more different monomers wherein at least one is a (meth)acrylate monomer, the polyepoxide, or combinations thereof.

10 13. The acoustic sensor of claim 11 wherein the immobilization layer comprises the soluble polymer having two or more pendant groups independently selected from the group consisting of functional groups (I), (II), (III), and (IV).

15 14. The acoustic sensor of claim 1 comprising an immobilizing waveguide layer.

15. The acoustic sensor of claim 14 wherein the immobilizing waveguide layer comprises the soluble polymer having two or more pendant groups independently selected from the group consisting of functional groups (I), (II), (III), and (IV).

20 16. The acoustic sensor of claim 15 wherein the immobilizing waveguide layer comprises a random polymer having a molecular weight of at least 1000, and is of the following formula:



25 wherein:

each R'' is independently H or CH<sub>3</sub>;

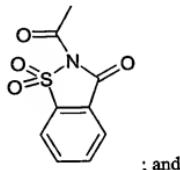
each E is -O- or -NR'<sup>f</sup>, where R'<sup>f</sup> is hydrogen or alkyl;

m', n', o', p' represent the number of times each moiety is present in the polymer;

-112-

X', Y', Z', and W' are independently selected from the group consisting of alkyl, aryl, hydroxy ester, alkoxyalkyl, alkoxyaryl, ether, fluoroalkyl, trialkoxysilylalkyl, and N-containing groups; and

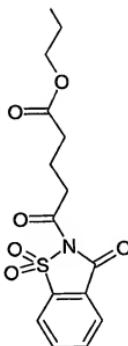
at least one of X', Y', Z', or W' includes an acylsulfonamide group of the following formula:



; and

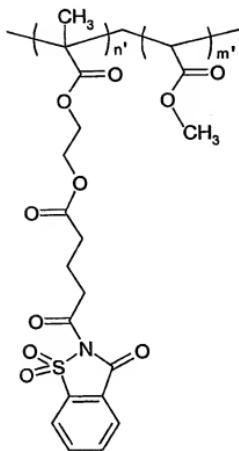
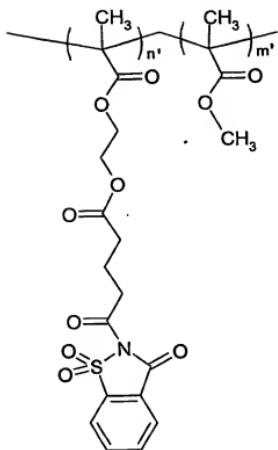
the polymer includes at least two distinct moieties.

17. The acoustic sensor of claim 16 wherein at least one of X', Y', Z', or W' is the following group:

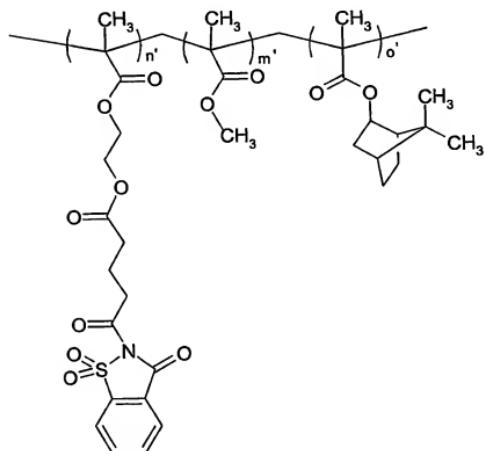
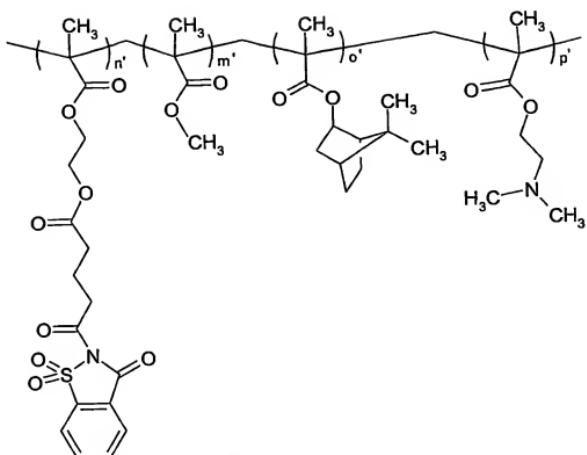


18. The acoustic sensor of claim 17 wherein the soluble polymer is selected from the group consisting of:

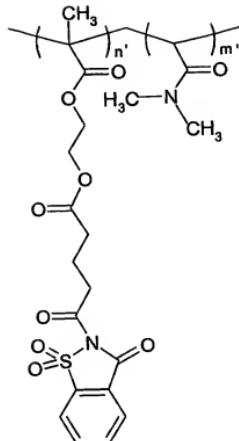
-113-



-114-

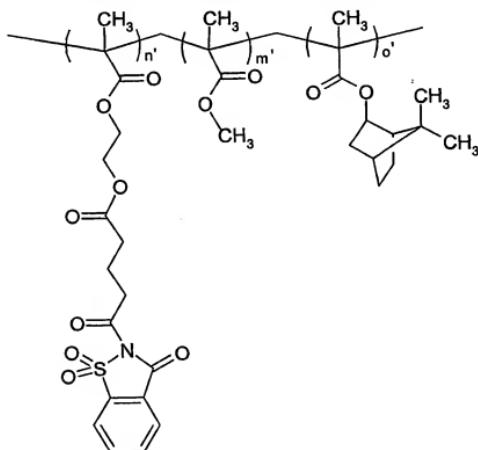


and

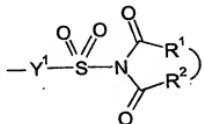


wherein  $m'$ ,  $n'$ ,  $o'$ , and  $p'$  represent the number of times each moiety is present in the polymer.

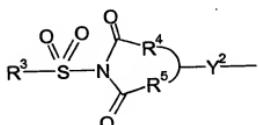
5 19. The acoustic sensor of claim 18 wherein the soluble polymer has the formula:



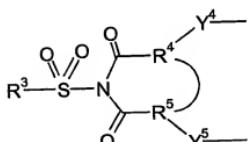
20. An acoustic sensor comprising a soluble polymer having two or more pendant groups independently selected from the group consisting of functional groups having the following formulas:



(I);



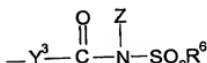
(II);



10

(III);

and



15

(IV);

wherein:

20      R<sup>1</sup> and R<sup>2</sup> together with a dicarboximide group to which they are attached form a four to eight membered heterocyclic or heterobicyclic group that can be

fused to an optional aromatic group, optional saturated or unsaturated cyclic group, or optional saturated or unsaturated bicyclic group;

R<sup>3</sup> is an alkyl, aryl, aralkyl, or -NR<sup>a</sup>R<sup>b</sup> wherein R<sup>a</sup> and R<sup>b</sup> are each an alkyl group or taken together with the nitrogen atom to which they are attached form a four to eight membered heterocyclic group;

R<sup>4</sup> and R<sup>5</sup> together with a dicarboximide group to which they are attached form a four to eight membered heterocyclic or heterobicyclic group that can be fused to an optional aromatic group, optional saturated or unsaturated cyclic group, or optional saturated or unsaturated bicyclic group;

R<sup>6</sup> is an alkyl, fluoroalkyl, chloroalkyl, aryl, -NR<sup>c</sup>R<sup>d</sup> wherein R<sup>c</sup> and R<sup>d</sup> are each an alkyl group or taken together with the nitrogen atom to which they are attached form a four to eight membered cyclic group, or R<sup>6</sup> taken together with R<sup>e</sup> and the groups to which they are attached form the four to eight membered heterocyclic or heterobicyclic group that can be fused to the optional aromatic group, optional saturated or unsaturated cyclic group, or optional saturated or unsaturated bicyclic group;

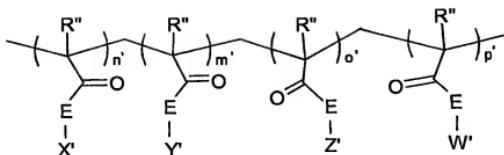
Z is an alkyl, aryl, or -(CO)R<sup>e</sup> wherein R<sup>e</sup> together with R<sup>f</sup> and groups to which they are attached form a four to eight membered heterocyclic or heterobicyclic group having a nitrogen heteroatom and a sulfur heteroatom, wherein said heterocyclic or heterobicyclic group can be fused to an optional aromatic group, optional saturated or unsaturated cyclic group, or optional saturated or unsaturated bicyclic group;

Y<sup>1</sup>, Y<sup>2</sup>, and Y<sup>3</sup> are each independently a single bond or a divalent group selected from the group consisting of an alkylene, heteroalkylene, arylene, carbonyl, carbonyloxy, carbonylimino, oxy, thio, -NR<sup>f</sup>- where R<sup>f</sup> is hydrogen or alkyl, and combinations thereof; and

Y<sup>4</sup> and Y<sup>5</sup> are each a bond.

21. The acoustic sensor of claim 20 comprising an immobilizing waveguide layer, wherein the immobilizing waveguide layer comprises the soluble polymer.

22. The acoustic sensor of claim 21 wherein the soluble polymer is a random polymer having a molecular weight of at least 1000, and is of the following formula:



wherein:

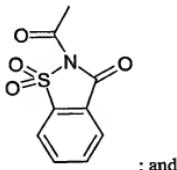
each R'' is independently H or CH<sub>3</sub>;

5 each E is -O- or -NR<sup>f</sup>, where R<sup>f</sup> is hydrogen or alkyl;

m', n', o', p' represent the number of times each moiety is present in the polymer;

X', Y', Z', and W' are independently selected from the group consisting of alkyl, aryl, hydroxy ester, alkoxyalkyl, alkoxyaryl, ether, fluoroalkyl, trialkoxysilylalkyl, and N-containing groups; and

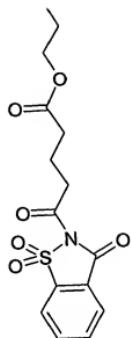
10 at least one of X', Y', Z', or W' includes an acylsulfonamide group of the following formula:



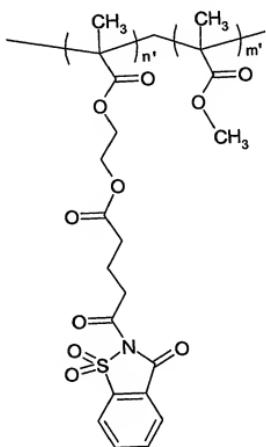
; and

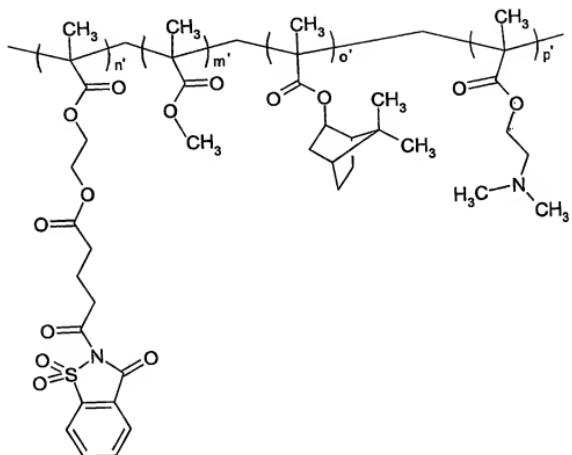
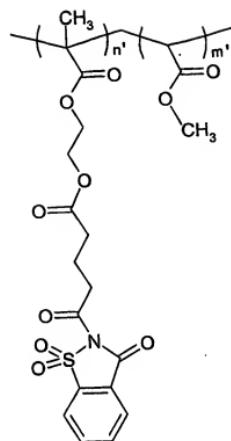
the polymer includes at least two distinct moieties.

15 23. The acoustic sensor of claim 22 wherein at least one of X', Y', Z', or W' is the following group:

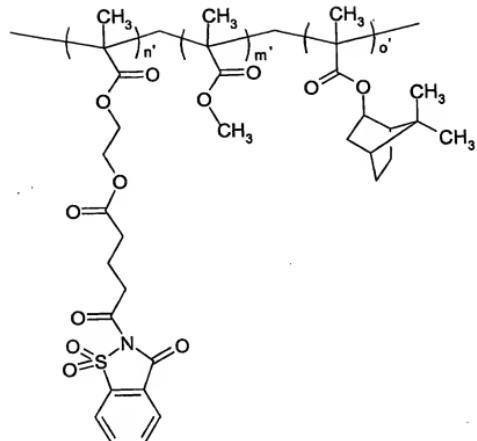


24. The acoustic sensor of claim 23 wherein the soluble polymer is selected from the group consisting of:

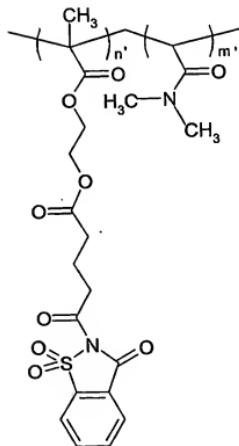




-121-



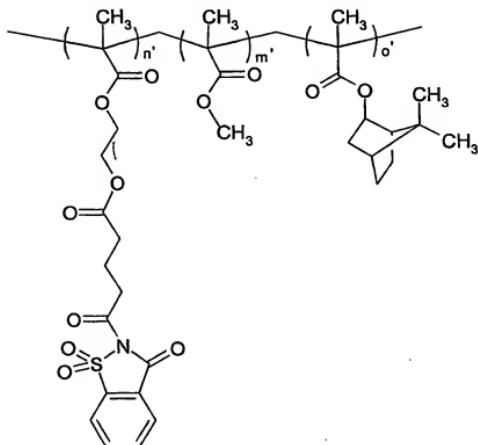
and



5

wherein  $m'$ ,  $n'$ ,  $o'$ , and  $p'$  represent the number of times each moiety is present in the polymer.

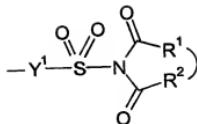
25. The acoustic sensor of claim 24 wherein the soluble polymer has the formula:



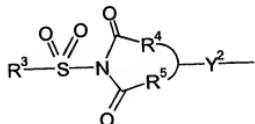
26. The acoustic sensor of claim 20 comprising a waveguide layer and an  
immobilization overlayer, wherein the immobilization overlayer comprises the soluble  
polymer.

27. The acoustic sensor of claim 26 wherein the waveguide layer comprises a  
polyepoxide, a polymer derived from one or more (meth)acrylate monomers, a styrene-  
containing polymer, a polymer derived from N-vinylcarbazole and optionally other  
ethylenically unsaturated monomers, a polyimide, a VF<sub>2</sub>-containing fluoropolymer, or  
combinations thereof.

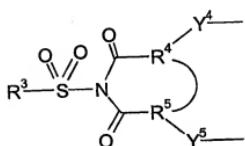
28. A method of coating an acoustic sensor, the method comprising:  
applying a soluble polymer to a surface of the acoustic sensor using a non-  
contact deposition technique, wherein the soluble polymer has two or more pendant  
groups independently selected from the group consisting of functional groups having  
the following formulas:



(I);



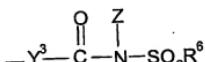
5 (II);



(III);

10

and



(IV);

wherein:

15

$\text{R}^1$  and  $\text{R}^2$  together with a dicarboximide group to which they are attached form a four to eight membered heterocyclic or heterobicyclic group that can be fused to an optional aromatic group, optional saturated or unsaturated cyclic group, or optional saturated or unsaturated bicyclic group;

20

$\text{R}^3$  is an alkyl, aryl, aralkyl, or  $-\text{NR}^{\text{a}}\text{R}^{\text{b}}$  wherein  $\text{R}^{\text{a}}$  and  $\text{R}^{\text{b}}$  are each an alkyl group or taken together with the nitrogen atom to which they are attached form a four to eight membered heterocyclic group;

R<sup>4</sup> and R<sup>5</sup> together with a dicarboximide group to which they are attached form a four to eight membered heterocyclic or heterobicyclic group that can be fused to an optional aromatic group, optional saturated or unsaturated cyclic group, or optional saturated or unsaturated bicyclic group;

5 R<sup>6</sup> is an alkyl, fluoroalkyl, chloroalkyl, aryl, -NR<sup>c</sup>R<sup>d</sup> wherein R<sup>c</sup> and R<sup>d</sup> are each an alkyl group or taken together with the nitrogen atom to which they are attached form a four to eight membered cyclic group, or R<sup>6</sup> taken together with R<sup>e</sup> and the groups to which they are attached form the four to eight membered heterocyclic or heterobicyclic group that can be fused to the optional aromatic group, optional 10 saturated or unsaturated cyclic group, or optional saturated or unsaturated bicyclic group;

15 Z is an alkyl, aryl, or -(CO)R<sup>e</sup> wherein R<sup>e</sup> together with R<sup>6</sup> and groups to which they are attached form a four to eight membered heterocyclic or heterobicyclic group having a nitrogen heteroatom and a sulfur heteroatom, wherein said heterocyclic or heterobicyclic group can be fused to an optional aromatic group, optional saturated or unsaturated cyclic group, or optional saturated or unsaturated bicyclic group;

20 Y<sup>1</sup>, Y<sup>2</sup>, and Y<sup>3</sup> are each independently a single bond or a divalent group selected from the group consisting of an alkylenes, heteroalkylene, arylene, carbonyl, carbonyloxy, carbonylimino, oxy, thio, -NR<sup>f</sup>-, where R<sup>f</sup> is hydrogen or alkyl, and combinations thereof; and

Y<sup>4</sup> and Y<sup>5</sup> are each a bond.

29. The method of claim 28 wherein the non-contact deposition technique comprises using an aerosol jet deposition process.

25 30. The method of claim 28 wherein the acoustic sensor comprises a waveguide layer and the soluble polymer is applied to the surface of the waveguide layer.